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CONICAL LENS PROBLEM AND ITS REMEDY

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Abstract- Conical lens gimmicks play important role in our now-a-days engineering science. They can be applied in various intentions. In gimmicks applying these lenses can be brought up or processed various ways which can give gained results for its procedures. Methods like image processing can be applied to have a calibre designed effects. Applying a fuzzy logic design it hand over better results while functioning in night visual sense devices during dense fog and rain.

Keywords- Axicons; annulus; cone; eigen; fuzzy filter

I. INTRODUCTION

Conical lens which came after a conventional lens, it can concentrate laser light to a ring figure. An axicon will change a parallel laser beam into a ring. Axicons are optical components that develop Bessel beams, i.e., long and constringe focal lines along the optical axis. The constringe concentrate makes them utile in e.g. alignment, harmonic generation, and atom trapping, and they are also used to gain the longitudinal range of diligences such as triangulation, light sectioning, and optical cohesiveness tomography. These lenses are commonly constructed as refractive cones or as circular diffractive rankling. They can also be constructed from normal spherical surfaces, applying the spherical deviance to make the long focal line. The advantage of the lens axicon is that it is well constructed. Axicons can be constructed in many various ways: as refractive of reflective cone axicons, as circular diffractive rankling, and as lens arrangements with spherical deviance. While a normal lens makes a point concentrate, an axicon develops focal lines extended along the optical axis.

II. PREVIOUS WORK - THE THEORY

A. VARIOUS KINDS OF AXICONS

1) Fourier metamorphose of an annulus

A way of producing a Bessel beam is to utilize the Fourier metamorphose of a constringe ring figured hole [3]. If an object is put in the back focal plane of a lens, in commonly incident plane wave illumination, its Fourier metamorphose will come out in the front focal plane of the lens. The Fourier metamorphose of a ring hole is the zero-order Bessel function [1] and consequently the setup in Fig. will generate a Bessel beam after the lens.

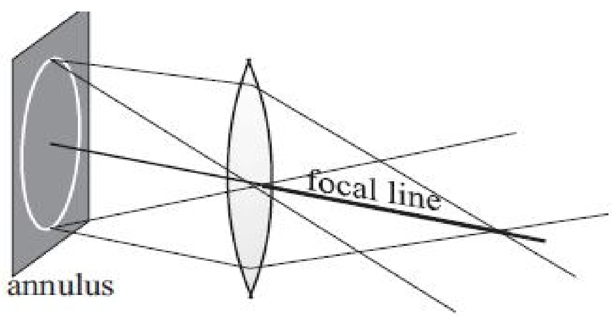

Fig – 1: *Refractive and reflective cone axicons*

The oldest kind of axicon, explained by McLeod in 1954 is the refracting cone [5]. A glass cone will refract whole rays at the like angle comparative to the optical axis, thus causing a Bessel beam to come out. The phase function of the axicon in fig will be

$$\phi(\rho) = (n-1)\rho \cos \delta,$$

Where n is the refractive index of the axicon, and δ is the prism angle, as display in Fig.2. A similar effect can be obtained applying a reflecting cone [4]
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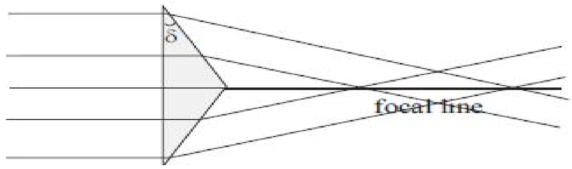


***Fig – 2:** A refractive cone axicon. The length and width of its focal line are fixed by the prism angle δ and the refractive index n.*

2) Conveying ways applied to axicons for image

The characteristics of the axicon focal line can be analyzed by the conveying-way method, which also gives physical insight into how the focal line is formed. The geometry of the axicon is various; the Eigen functions will be various [7]. Applying a change of variables, however, they can be found in a form very alike to those in Section.

3) Exact ways

In this approach path, the conveying ways were applied for the first time to the axicon geometry: circular or annular hole to on-axis line concentrate. Previously, alike analysis had only been done in the two-dimensional case: from a line hole to an on-axis region [101, 102] [4]. The geometry is the like as in Fig1 [2]. The transmitting region is determined as the annular hole of the axicon, of inner and outer radii R_1 and R_2, while the receiving region is a section of the optical axis located between d_1 and d_2. Here, d_1 and d_2 do not necessarily announce the ends of the focal line [2], as in the earlier section, but simply the limits of the receiving region. In order to observe the whole focal line, the limits should be put outside the focal region. If the axicon is rotationally symmetric the angular part of the diffraction integral can be measured. For on-axis points, i.e., for $\rho = 0$, it becomes

$$U_{\mathrm{out}}(z) = \frac{k \exp(\mathrm{i}kz)}{\mathrm{i}z} \int_{R_1}^{R_2} U_{\mathrm{in}}(\rho)\rho' \exp\left(\mathrm{i}k\frac{\rho'^2}{2z}\right) \mathrm{d}\rho' , \tag{1}$$

Where Uout(z) is the field on the optical axis and Uin(ρ′) is the field leaving the axicon hole. The phase function of the axicon is admitted in Uin(ρ′). After a change of variables $q = \rho'^2 - (R_1^2 + R_2^2)/2$ the integral reads

$$U_{\mathrm{out}}(z) = \frac{k \exp(\mathrm{i}kz)}{2\mathrm{i}z} \exp\left(\frac{\mathrm{i}k}{2z}\frac{R_1^2 + R_2^2}{2}\right) \int_{-Q}^{Q} \widetilde{U}_{\mathrm{in}}(q) \exp\left(\frac{\mathrm{i}k}{2z}q\right) \mathrm{d}q$$

$\widetilde{U}_{\mathrm{in}}(q) = U_{\mathrm{in}}(\rho)$ and $Q = (R_2^2 - R_1^2)/2$. Now the Green function is

$$G(z,q) = \frac{k \exp(\mathrm{i}kz)}{2\mathrm{i}z} \exp\left(\frac{\mathrm{i}k}{2z}\frac{R_1^2 + R_2^2}{2}\right) \exp\left(\frac{\mathrm{i}k}{2z}q\right) . \tag{2}$$

Most of the terms in the Green function are already separated in z and q, and can be excluded in the like way as the quadratic phase factors [5]. The other term $\exp(\mathrm{i}kq/2z)$ is elaborated bi-orthogonally. The Eigen values and the eigen functions, now with whole terms admitted, are found to be

$$g_n = i^{(n-1)}\sqrt{k\pi} \cdot |g_n| , \tag{3}$$

$$a_n(q) = \exp(-\frac{\mathrm{i}kD_{\mathrm{sum}}}{2}q)\alpha_n(q) , \tag{4}$$

$$b_n(z) = \frac{1}{z}\exp(\mathrm{i}kz)\exp\left(\frac{\mathrm{i}k}{2z}\frac{R_1^2 + R_2^2}{2}\right)\beta_n\left(\frac{1}{z} - D_{\mathrm{sum}}\right) . \tag{5}$$

Here $D_{sum} = (1/d_1 + 1/d_2)/2$, $D_{diff} = (1/d_1 - 1/d_2)/2$, $\alpha n(q)$ is the PSWF of ordern, scale Q and bandwidth $kD_{diff}/2$, and $\beta n(1/z - D_{sum})$ is the PSWF of order n, scale D_{diff} and bandwidth $kQ/2$. The accuracy of these expressions are confirmed by numerical generation [3]. Interesting knowledge of the data content and the axial resolve can be found from these expressions [6]. The number of degrees of freedom, i.e., the number of usable data channels, is

$$N = \frac{kQD_{\text{diff}}}{\pi} = \frac{1}{2\lambda}\left(R_2^2 - R_1^2\right)\left(\frac{1}{d_1} - \frac{1}{d_2}\right). \quad (6)$$

If the hole of the axicon is gained, or the receiving region on the optical axis is gained, the number of ways will grow [3]. Thus more data can be transmitted in this particular geometry. It is also interesting to analyze the on-axis resolve. A PSWF of ordern always passes through zero n times, and function number N is the most rapidly oscillating function which is generated. If the analysis is done in the variable
$s = 1/z - D_{sum}$,

The distance between two adjacent zeros will be

$$\Delta s = 2D_{diff} / N = 2Y / \left(R_2^2 - R_1^2\right)$$

Changing variables to the z area through the relation

$$\Delta s = 1/(z + \Delta z) - 1/z$$

Leads to

$$\Delta z = \frac{z^2 \Delta s}{1 - z\Delta s}. \quad (7)$$

Since the highest on-axis frequency to be resolved is
$f_z = 1/\Delta z$, the axial resolve is
Given

$$f_z = \frac{1}{z}\left(\frac{R_2^2 - R_1^2}{2\lambda z} - 1\right). \quad (8)$$

The value of f_z looks only on the size of the hole and on the position on the z axis [5]. There is no look after on the chosen observation area between d_1 and d_2, which is sensible since the resolve should not change just because a larger or smaller part of the axis is looked at [2]. In Fig., the variation with z of the on-axis resolve is shown.

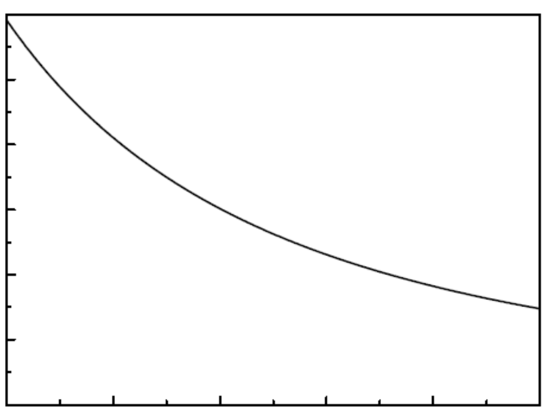


Fig – 3: *The on-axis resolve changes with z according to Eq. (8). The radii are R_1 = 10 mm and R_2 = 5.0 mm, and the wavelength λ = 633 nm.*

It is well known that the depth of concentrate of a lens will gain if the focal length, and consequently the distance from the hole, is gained. A gained depth of concentrate means a diminished axial resolve, and since the analysis above applies not only to axicons but also to lenses, it is sensible that the resolve diminishes when the distance to the axicon gains.

B. NIGHT VISION

Night vision as referenced here is that method that allows for us with the miracle of vision in total darkness and the betterment of vision in low light environments [4]. This method is an amalgam of several various ways each having its own advantages and disadvantages. The most common ways as explained below are Low-Light Imaging, Thermal Imaging and Near-infrared Illumination [3]. The most similar diligences include night driving or flying, night security and surveillance wildlife notified, sleep lab monitoring and explore and saving [7]. A large range of night vision products are usable to suit the different requirements that may live for these diligences:

1. WORKING PRINCIPLE:

This method of night vision increases the usable light to achieve better vision [6]. An objective lens concentrates usable light (photons) on the photocathode of an image intensifier. The light energy causes electrons to be released from the cathode which are accelerated by an electric field to gain their speed (energy level). These electrons get in holes in a micro channel plate and bounce off the internal specially-coated walls which generate more electrons as the electrons bounce through [4]. This makes a denser "cloud" of electrons representing an intensified version of the original image. The last stage of the image intensifier regards electrons hitting a phosphor screen. The energy of the electrons makes the phosphor glow [3]. The visual light displays the desired view to the user or to an attached photographic camera or video device. A green phosphor is used in these diligences because the human eye can differentiate more shades of green than any other colour, allowing for greater differentiation of objects in the picture [2]. Whole image intensifiers operate in the above fashion. Technological differences over the past 40 years have resulted in substantial betterment to the carrying into action of these devices. The different paradigms of technology have been commonly identified by distinct generations of image intensifiers. Intensified camera arrangements usually incorporate an image intensifier to make a brighter image of the low-light scene which is then viewed by a traditional camera.

Whole Gen 3 image intensified night vision products on the market today have one thing in common: they develop a green output image. But that’s where the similarities end.

2. CHARACTERISTICS OF NIGHT VISION

Applying intensified night vision is various from applying binoculars or your own eyes. Objects that come out light during the day but have a dull surface may come out darker through the night vision unit, than objects that are dark during the day but have a highly reflective surface. For example, a shiny dark coloured jacket may come out brighter than a light coloured jacket with a dull surface [5]. Night vision is very responsive to reflective ambient light; therefore, the light reflecting off of fog or heavy rain causes much more light to go toward the night vision unit and may degrade its carrying into action. A few black spots throughout the image area are also inherent characteristics of whole night vision technology. These spots will remain constant and should not gain in size or number [3]

III. PROPOSED WORK

We have seen very before that what is histogram and it’s advantage to apply. Now we have to go through some filter to reduce or delete the noise. By histogram we have already authorize the picture by gain the contrast level of each and every pixel. Now we require working with that picture. To reduce noise we need to work with some filter. But as per limitation we can’t work with many filters in a single code. So at first I choose to develop a picture applying most rarefied logic, fuzzy logic. As I say this logic is rarefied but the adeptness to develop this code that it will work with some vital rule give us very respectful output. To process a fuzzy filter three steps is needed

1. Smoothing,
2. Fuzziation,
3. Defuzziation.

To code this we need to follow the algorithm:

1. *Take a zero size matrix according to the size of input image matrix.*
2. *Find the derivative of the input image matrix. For this find the maximum number and minimum number and mean of the input image matrix.*
3. *According to that derivative fire fuzzy rule.*
4. *After doing this the new value of each block put in the new matrix containing zero.*
5. *Change the new matrix and display the picture corresponding to that matrix.*

IV. FUZZY FILTER

Fig – 4: *Input image*

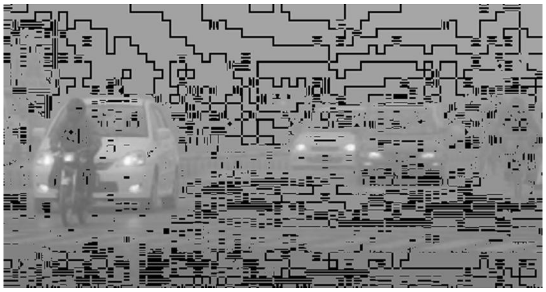


Fig – 5: *Output image of fuzzy filter*

A. DISADVANTAGE OF FUZZY FILTER:

There are several disadvantages in fuzzy filter:

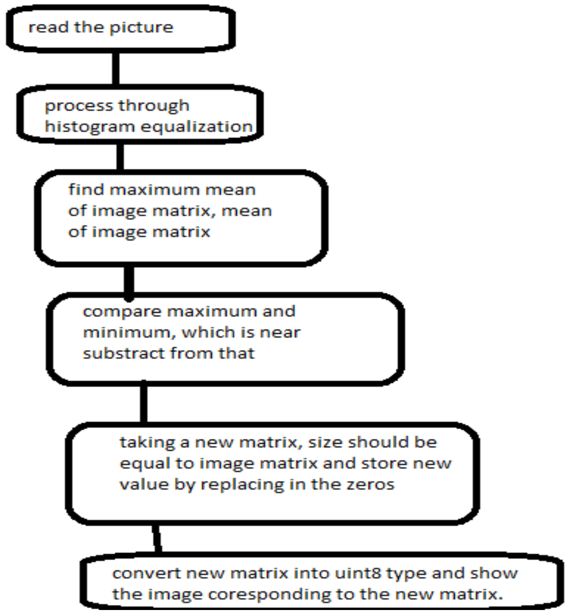
1. This is too rarified. To code this it is needed to find out the fuzzy derivative. Then a bunch of rule should be thrown to fuzziation.
2. After fuzziation it is needed to defuzziation. So from here we can realize this too much rarefied rather than mead filter, Gaussian filter and average filter.
3. As this code is too much rarified it is required more than 10 sec to process an image.
4. As it is seen for faint foggy image this filter make image noisier.

B. DEVELOPED CODE OF FUZZ RULE:

Now eliminating those fuzzy rules we have developed the code well. In our code we have measure the percentage of fog and then we eliminate that percentage from each and every pixel enlarges the contrast. We have got this output.

Fig – 6: *Output image by developed code of fuzz rule*

C. FLOW CHART OF THE DEVELOPED FUZZY LOGIC FILTER:



V. CONCLUSION

By the help of this developed algorithm many disruptions in its uses can be carried on. The advancement of this technique further can lead to many fruitful results in upcoming methods, as we can see after applying this developed rule it gives us improve results about what we are applying so far in this area.

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Though what matters most in a journal are its contents, it is the parts of introduction, previous work, working principal, characteristics of Night vision, equations, proposed work, filters used, disadvantages, remedy (Specially in images related journals), block diagram, conclusion etc. that make it an attractive proposition. We have pinned our hopes that the readers would appreciate this approach. And lastly many thanks to Mrs. Moumita who cheered me in good times, encouraged me in bad times, understood me at all times and for listening to my works and dreams. She also gives some important advices to complete journal.

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